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SUGAR PRICES FOR MONTH ENDING JULY 12, 1907.

	Centrifugals.	Beets.
June 14	3.73¢	9s 9d
June 21	3.705¢	9s 9d
June 28	3.875¢	9s 9d
July 5	3.835¢	9s 6¾d
July 12	3.835¢	9s 5¼d

Willett & Gray in their weekly statistical of July 3 say:

Raws.—The notable feature of the week under review is the somewhat mysterious weakness of the European markets for beet root sugar.

After holding unexpectedly firm and steady during the long selling of the Cuba crop at prices much below the beet parity, the markets abroad have suddenly developed a declining tendency without giving reasons therefor, which foreshadows a coming together of values of cane and beet sugar.

This may possibly be the meaning of the decline that is made with a view of inviting business from America as soon as refiners have used their present surplus stocks. No doubt the decline will prove a good move in bringing Java sugars to the front for America on the basis of beet sugar quotations, at the same parity as Cuba Centrifugals. At the moment beet is still .16½c. above the Cuban parity.

It is not likely that Cuba will decline materially with its moderate remaining stocks, even if Beet sugar comes to its level of value, which is not at all probable. An extreme decline in Beet would be to 9s. 3d. f. o. b. Hamburg, which is the parity of 3.93c. for Centrifugals at New York, and, it is reasonable to expect prices in our market to rise to that level before very long, in view of the comparatively small quantity of sugar which will be available for shipment from Cuba during the next few months.

It is about the time of the year when Cuba generally gives way to Java and our refiners take liberally from that crop for use here late in the season. The last report of business in Javas was given out early in May, up to which time it is believed that some 75,000 tons were placed for shipment to the United States during June and July at 10s. 1½d. to 10s. 6d. c. & f., equal to 3.94c. to 4.02c. duty paid, basis of 96° test. Our cable advices from Batavia of shipment last month are not yet received, but it is estimated that about 40,000 tons were exported in June with U. S. options.

At the opening of the week Beet sugars were quoted at 9s. 9d., while our local market was steady at 3.87½c. for 96° test, but, on the decline in Europe to 9s. 6¾d. for Beet, prices for Centrifugals on the spot, here, dropped to 3.83½c. Meanwhile distant sugars have been held at 2½c. c. & f. 95° test, equal to 3.89c. landed for 96° test, with but little pressure to sell.

The close in Europe is steadier with Beet quoted at 9s. 7d. for July, 9s. 6d. for October-December and 9s. 7d. for January-March.

Messrs. Czarnikow, Macdougall & Co. under date of July 5 reported:

The pronounced improvement in our raw sugar market last week was of short duration. Instead of being further strengthened by the better statistical situation and by increased consumption, the market came suddenly to a standstill after the large business reported in our last issue, thus checking, for the time being at least, the upward movement which had been expected to continue.

The decline in European Beets, though slight, was no doubt what acted as a curb to our market, causing holders of sugar to show a greater desire to sell than the refiners manifested to buy, a condition which is always apparent on a decline in beets, no matter how great the disparity between our market and that of Europe, while it would seem reasonable to expect that a slight decline, such as the last, would have no influence here when European prices are so much above ours. So great a disparity cannot always exist, especially during the summer months. Based on today's quotations for Beet (9s. 6¾d. f. o. b. Hamburg) our spot market should be 4c., whereas last sales are recorded at 3.835c.

European prices broke from 9s. 9d., July; 9s. 9½d., August; 9s. 6¼d., October-December to 9s. 6¾d., July; 9s. 7¼d., August; 9s. 5d., October-December, today's closing quotations.

No special crop report was published which might have caused lower prices in Europe. Mr. Licht reported the weather unfavorable this week. It must, therefore, have been the result of local influences, possibly of speculators realizing.

The combined stocks in the United States and Cuba are now 639,000 tons, against 677,800 tons last week and 572,000 tons last year. While this shows an excess of 67,000 tons, as compared with last year's stocks, we still would require 242,000 tons from Europe and Java to reach the total received from those sources in 1906, assuming that receipts here from other sources will be equal to those of last year and that consumption will not be less; the latter, of course, depends upon the outcome of the fruit crop and weather conditions, neither of which is very satisfactory, so far.

SUGAR NOTES.

SUGAR CANE EXPERIMENTS IN BRITISH GUIANA. The report of the Board of Agriculture of British Guiana for the year 1905-6 states that the results obtained in the experiment with varieties of cane, and the progress made in the Colony are very encouraging. Attention is being given to raising and testing new varieties, and experiments are also being carried on with the object of ascertaining the more promising of the new varieties.

MACHINE CANE CUTTER. An invention which promises great things to sugar growers is reported by the China Telegraph from East Java. An engineer on one of the sugar estates has invented an implement which, so says expert opinion, will shortly be used wherever time and money are of value to planters. It is a machine which simplifies the cutting of sugar cane in the fields. By it two men can cut 272 piculs (18 tons) of cane a day. Further experimenting will be proceeded with.

DECREASE OF IMPORTS TO INDIA. On account of agitators in India circulating a false report that all sugars manufactured in Europe are refined by the aid of bones, the imports of this commodity into India has been greatly affected.

STEAM PLOWS IN TRINIDAD. It is asserted that by the use of steam plows and other labor-saving devices an increase in yield of sugar cane of 50 per cent. has been effected in Trinidad, thus assuring the continuance of an industry which was in danger of becoming extinct through the effects of competition of Cuba and Porto Rico.

SUGAR IN MOROCCO. Consul-General Hoffman Philip of Tangier, in response to inquiries, reports that sugar is a valuable article of import into Morocco, and is principally supplied by Austria, France, Germany and Great Britain in the order named. The total importation of sugar into Morocco during the year 1904 amounted to $2,589,815. Of this amount the coast

town of Casablanca received $560,695, Mogador $508,740, Saffi $488,135, Rabat $486,825 and Tangier $110,915.

The amount of sugar imported into Tangier during the year 1905 was valued at $139,550. The greater part of this sugar comes in the form of conical loaves of various sizes, which is the shape in demand among the native inbabitants, by whom large quantities are consumed.

How the National Forests Serve the Public.—"The Use of the National Forests," a publication just printed by the Department of Agriculture, is a brief, clear manual for public information as to the forest policy of the National Government.

It is too true, as the short preface to the public says, that "many people do not know what National Forests are. Others may have heard much about them, but have no idea of their true purpose and use." It is the object of this publication to explain just what the National Forests mean, what they are for, and how to use them.

In the first place, it is explained how the Forests are created and how their boundaries are drawn. Next, their direct use and value are shown from the point of view of the homeseeker, the prospector and miner, the user of timber, the user of the range, the user of water, and other users of Forest resources. Third, it is shown how the Forests are intended for use, for the production of usable products, and for the establishment and maintenance of homes; how on all of them the timber is protected from fire, the water flow is kept steady, the forage on the range is increased and guarded from abuse; and how, in addition, they serve as great public playgrounds and as breeding places and refuges for game. Finally, the management of the National Forests is described.

Here it is that the great usefulness of the Forests is brought out most clearly and strikingly; for the Forests are managed by the people in their own interests, and every means is used to meet the desires and wants of all Forest users half way by dealing with them in the main directly on the ground and in all cases with the utmost practicable dispatch and freedom from red tape.

In a word, the special interest of this manual lies in its showing that the Forest policy of the Government, both in principle and in practice, is for the benefit of the ordinary man, for the benefit of every citizen equally. There is still a tendency to think of the National Forests as "preserves" closed to use, and to leave the public lands exposed to unregulated individual exploitation. Where these misapprehensions still prevail "The Use of the National Forests" will go far to correct them.

The book is written by Mr. Frederick E. Olmsted, whose intimate knowledge of conditions in the West and the policy under which the National Forests are managed especially fits him to deal with the subject.

LABOR FOR QUEENSLAND.—In pursuance of the policy initiated by the Queensland authorities to obtain white labor for their cane fields, recruiting has been taking place among the unemployed in London, and a first contingent of British laborers, amounting to 150, left England for Australia about a month ago. The wages will vary from 32s. 6d. to 45s. per week, according to the class of work they undertake. We gather that the term of the contract will last till December 31, 1908. It is to be noted that Queensland is not the only cane country which suffers from a scarcity of labor. Louisiana's plight is old history by now, and even the Hawaiian Islands are getting into difficulties. Both these districts are endeavoring to obtain laborers from Malaga, Spain.—*International Sugar Journal.*

NOTES FROM LEEWARD ISLANDS.

Sugar is the principal industry of Antigua and St. Kitt's, but, owing to a prolonged drought, the crop of 1905-6 in the former island was particularly short. In Nevis, and especially in Montserrat, the sugar industry is in a decadent condition, but it would appear that cotton is gradually taking the place of cane as the staple crop.

The central facories at Gunthorpe's and Bendal's, Antigua, were steadily at work during 1905-6; but on account of the particularly unfavourable season, there was a shortage of crop and a deficiency of water for proper maceration of the crushed canes in the mills. The profits from these concerns were considerably lessened, and in the case of the Antigua Sugar Factory at Gunthorpe's, after charging the expenses of the year and placing £2,000 to the sinking fund, only £331 17s. 10d. remained for distribution to the 'contracting planters.' The present year (1906-7), however, has been much more favourable and the prospects for a successful working are decidedly hopeful, since a better appreciation of the advantages offered and the augmented railway facilities have had the effect of considerably increasing the area under cultivation in cane, especially with peasant proprietors.

The experiments with sugar-cane carried on, under the direction of the Imperial Department of Agriculure, at Antigua and St. Kitt's, with a view to finding varieties of sugar-cane which are likely to give increased yields of sugar, as well as being more resistant to disease, and to ascertaining the effect produced by artificial manures when used in addition to the usual applications of pen manure employed in local practice, have been continued. The results show that B. 208 and Sealy Seedling may be recommended for extended trial at the hands of planters, that the use of artificial manures for plant canes is unremunerative, provided that the usual quantity of good pen manure is applied, and

that increased crops from ratoons are obtainable by applications of artificial manures.

Encouraging progress has been made in the cultivation of Sea Island cotton during the past year; 1,800 acres were under cultivation in Antigua, 1,100 in Montserrat, 3,000 in St. Kitt's-Nevis, and 1,000 in Anguilla; while in the Virgin Islands the cultivation of cotton is steadily being extended.

In St. Kitt's, most of the cotton crop occupies the position of a rotation crop with sugar-cane only a small part being planted as a main crop; but in Nevis and Montserrat it would appear that coton is gradually becoming the main crop.

DOCTOR COBB'S BULLETIN ON FUNGUS MALADIES OF THE SUGAR CANE.

We print below a review by "Nature" of Doctor Cobb's Bulletin on Fungus Maladies of the sugar cane, that indicates what others think of the work of an institution which we believe to be at the head of the sugar experiment stations of the world:

"The experiment station of the Hawaiian Sugar Planters' Association has issued as Bulletin No. 5 a remarkable publication which not only deals in a very comprehensive and thorough way with the fungus enemies of the sugar cane, but also contains a series of valuable notes on associated insects and nematodes.

"The volume has bound with it also Bulletin No. 4 of the same station, and by the same author. This bulletin is on some elements of plant pathology. In the course of the work mention is made of new blights found in the cane-fields of Hawaii, and of the new and threatening aspects of blights already known.

"Part I is introductory, and may be passed over. Part II deals with the root disease of sugar cane. In this section, which covers eighty-five pages, we have a most accurate and interesting description of the strange Ithyphallus fungus, which is one of the causes of root disease. 'Time alone can show,' Mr. Cobb tells us, "what the relative importance of the Ithyphallus fungus will be among the root-diseases of cane.' The serious losses caused by the fungus and its early history are first traced, and then the extraordinary fructifications are detailed and admirably illustrated. Then follows an account of the relations of insects to Ithyphallus. The author tells us that five species of flies, a beetle, and an ant frequent the fresh fructifications, and that some of the flies are so passionately fond of the sticky dark-green spore-mass that they can scarcely be driven away.

"Dispersal of this fungus by their agency, especially in the excreta, is proved, and although the flies are not named generically, they were known to be Sarcophagidae and Muscidae. The

work done in this subject is remarkable. It was shown that the spores are also carried in numbers on the feet. The spores from five of the fly tracks on glass were found to be 860,000 per track. Then follow notes on digestive power of flies, notes on defection (the number of spores found in a 'fly-speck' was shown to be 22,400,000 in some instances); even the weight of a fly ration is gone into with wonderful exactness.

"The use of lime as a fungicide is pointed out, and methods of cultivation given.

Parts III and IV deal with the leaf-splitting blight and rind disease; the first-named is shown to be due to Mycosphaerella. The pine-apple disease *(Thielaviopsis ethaceticus)* and the relation of certain insects and mites to it is detailed, and also the well-known yet little understood Eleau disease. Various experiments in the preparation and disinfection of cane cuttings and in testing cane varieties for their resistance to disease that have been carried out are recorded, and should prove most helpful to growers.

"The ninth and concluding section deals with free-living nematodes inhabiting the soil about the roots of cane and their relation to root diseases. The root diseases are very serious, and in these soil-inhabiting nematodes we have organisms capable, through their punctures, of givng entrance to smaller parasitic organisms that would hasten the death of the plant roots.

"The author describes no less than eighteen new species of these worms, and records five more found around the roots of diseased canes in Hawaii. They are included in the genera Dorylaimus, Tylenchus, Monochus, Prismatolaimus, Cephalobus, etc., and one new genus, Anthonema, is described.

"The whole work is excellent in every respect, not only from an economic point of view, but as an example of the thorough way in which such scientific investigations should be carried out."

THE PRODUCTION OF SUGAR IN THE ISLAND OF CUBA. CROPS 1906–1907.

(From Bulletin of Secretary of Agriculture of Cuba.)

The exportation and the amount of sugar on hand this 31st day of May, 1907, as compared with a similar date in 1906.

		1906		1907	
		SACKS	TONNAGE	SACKS	TONNAGE
EXPORTATION	Habana	555,912		658,917	
	Matanzas	770,788		1,117,723	
	Cardenas	709,615		876,773	
	Cienfuegos	1,200,335		1,310,389	
	Sagua	414,993		563,291	
	Caibarien	364,729		420,832	
	Guantanamo	210,734		353,375	
	Cuba	70,852		60,962	
	Manzanilla	280,168		324,734	
	Santa Cruz del Sur	63,095		71,525	
	Antilla	.....		118,801	
	Nipe Bay	.....		75,300	
	Nuevitas	129,700		164,685	
	Gibara & Puerto Padre	289,137		627,126	
	Zaza	.....		.....	
	Trinidad	63,556		57,807	
		5,123,614	731,945	6,802,240	971,749
AMOUNT ON HAND	Habana	582,920		739,787	
	Matanzas	532,181		360,390	
	Cardenas	395,923		464,637	
	Cienfuegos	261,009		402,335	
	Sagua	138,270		156,873	
	Caibarien	201,668		271,193	
	Guantanamo	59,535		76,872	
	Cuba	11,837		12,512	
	Manzanillo	19,580		10,010	
	Santa Cruz del Sur	12,770		.....	
	Antilla	.....		29,150	
	Nipe Bay	.....		14,835	
	Nuevitas	11,600		23,010	
	Gibara & Puerto Padre	9,400		30,512	
	Zaza	18,661		12,200	
	Trinidad	7,085		.....	
		2,262,439	323,206	2,604,316	372,045
Local consumption, 5 months			1,055,151		1,343,794
			19,480		19,870
Balance on hand Jan. 1, (old crop)			1,074,631		1,363,664
			19,450		.....
Rec'd until the 31 of May in port			1,055,181		1,363,664

NOTE.—1 Sack—320 lbs. 1 Ton—2,240 lbs.

JOAQUIN GUMA FREDERICK MEJER.

Havana, May 31, 1907.

BURNING OF CANE FIELDS IN CUBA.

A great loss annually results to the sugar planters in Cuba from the burning of cane fields, by disgruntled laborers or others who take this method of revenging themselves upon the owners of plantations. A recent number of *The American Sugar Industry and Beet Sugar Gazette* contains a letter from its Cuban correspondent which should be of interest to our planters, as showing one of the difficulties in cane growing suffered by the planters in that country. The letter, in part, is as follows:

"An interesting investigation has been made by Captain J. A. Ryan, of the Fifteenth Cavalry, regarding the burning of cane in Cuba. So many cane field fires were reported throughout the island during the past season that Captain Ryan, who is now aide to Provisional Governor Magoon, was either instructed or upon his own volition undertook to investigate the causes of so many fires and the losses which are sustained from them. Mr. Ryan, with regular army thoroughness, went into his subject deeply and made a very interesting report to the Chief of Staff. The most interesting fact in the report is that the losses sustained by burning fields of cane is comparatively speaking very little if the cane can be gotten to the mill immediately after it is burned. Sometimes planters actually set fire to their cane purposely in order that they may cut it more easily. The fires, as a rule, however, are caused by accident, though not often by criminal intent. The deadly cigarette very often causes a cane field to catch fire. The careless smoker in passing a field throws a half-burned cigarette into some straw beside the road and sometimes in twenty minutes a fire is started. Considering the fact that all the laborers in the fields smoke, it is considered a wonder that there are not many more fires. Locomotives on the little narrow-gauge railroads are often the cause of fires, and at other times they are started by contact with adjacent fields which are being burned purposely. Sometimes the laborers themselves set fire to the cane so as to make less work for themselves. The average laborer, working from three in the morning to eleven, will make from $1.80 to $2.50 per day cutting unburned cane, while working in burned cane he can increase his earning; owing to the lack of weeds hindering his work he earns as high as $3.60 per day. This fact sometimes causes a vicious man to attempt to burn a small patch of cane for the purpose of giving him an opportunity to make more money.

"The burning of old cane is often resorted to by plantation owners. Old cane is cane that was not cut the previous year and which in consequence has become choked with weeds and vines. Sometimes the plantation manager will burn his ordinary cane because of the scarcity of labor. Such cane, if burned and delivered to the mill and ground within five days, has but little loss, provided rain has not fallen upon it.

"Incendiary burnings are generally the result of blackmail or extortion. However, the methods employed to get the money would not suggest such a means. A party wishing to extort money from a planter does not threaten him, but merely approaches and asks for a loan. The planter knows that this mild request means, 'If you don't give me the money you will wake up some night to find your canefield burning.' As a rule the managers of sugar estates pay these parties, though they always deny having done so. They simply consider such methods the best means of preventing their fields from being set afire.

"Burning of insured cane is something that happens occasionally, and such occurrences sometimes reflect upon the owners or managers of the plantations, because it is assumed that they set fire to it for the purpose of obtaining the insurance.

"Two methods are generally employed by the incendiary in burning a cane field, namely, by candle and by phosphorus. If he wishes to set a field on fire by the first-named method he buys one that will burn for several hours and goes far into a cane field about two o'clock in the morning. He deposits the candle among a lot of dry cane and leaves it there. Several hours later when the candle burns to the dry leaves, it sets fire to the field and the fire-bug may be many miles away. The phosphorus method is just about as successful in giving the incendiary a chance to get away. Pure phosphorus can be bought in the drug stores and comes in sticks about the size of a candle. It burns at about a temperature of 97 degrees. The burner takes the stick and places it in the center of the field some time during the night. The stick remains in the field, getting hotter and hotter until about noon, when it ignites and sets the field of cane on fire. The candle burning in a forest of cane would, of course, not be noticeable, nor would the phosphorus. The danger from such causes induces owners of many large plantations to have a patrol of men to watch the fields all night long, and if any stranger appears he is hustled out of the vicinity without ceremony. For the purpose of preventing the cane cutters setting fire to the cane to make their work easier, some managers have a trusted employee with each gang in order to detect persons who would like to fire the cane."

MOLASSES AS A STOCK FOOD.

The utilization of molasses as a food for work animals on the plantations is becoming more and more general in Hawaii, and reports would indicate that other cane sugar countries are fully alive to the value of molasses for this purpose. It is said that the profits derived from the molasses and other by-products of the sugar beet in Germany are as great as that from the manufacture of sugar.

A recent number of the Louisiana Planter contains an interesting account of molasses importation to New Orleans and molasses as stock feed, as follows:

"Some little sensation has developed or has failed of development because of the reported arrival here of the steamship Russian Prince from Cuba with 810,000 gallons of Cuban molasses and the probable early arrival of half a dozen more similar cargoes. The importations of molasses into New Orleans is said to be paralleled only by the noted carrying of coals to New Castle. The writer of the account of this ship load of molasses has perhaps overlooked the fact that enormous quantities of foreign sugars are also imported into New Orleans and the records of our custom house show that it is one of the most important and we think the most important item of our imports from a duty paying point of view.

"Our local distilleries go to Cuba for molasses because they can't help themselves. The supply doesn't exist here. The Louisiana sugar crop of 1906 was only about 60 per cent. of the previous crop and the deficit in sugar produced was reflected in still greater proportion in the molasses produced. Last season the cane crop was short, the canes were harvested in good condition, no cane was frozen, the sugar yield was fairly good and the resulting low produce even proportionately less in quantity than usual. This low produce is ordinarily left in our sugar houses until June and then worked out into low grade sugars and final molasses. June this year was exceptionally cold and much of the low produce is only now coming out in July and if there be any surplus of such molasses for sale it will soon be on the market. If the two big distilleries combine to buy Louisiana molasses at less than its normal level of value they will surely come to grief and will have to go to Cuba or elsewhere to get their supplies. The molasses in adequate quantity doesn't exist here.

"Twenty-five years of actual experience in feeding molasses to mules and horses in a large way have demonstrated to us as to others the great value of Louisiana molasses as stock feed. Its chief value is to the actual producer who has it on the spot free of charges for freight and packages. John T. Moore said years ago that he would not sell his molasses in bulk under fifteen cents per gallon unless he had more on hand than could be consumed by his live stock. Dr. Stubbs has said time and again that a pound of molasses has the feeding value of a pound of corn. To a sugar planter who now has to buy corn at 70 cents per bushel, molasses is worth fifteen cents per gallon, as it will do his stock as much good, pound for pound, as corn.

"These are the reasons why there is but little and with some planters, no molasses offered for sale in Louisiana. There was but little over half a crop of molasses made or is but little over half a crop now making and that half crop will be required by

many of the sugar planters to last them until July of 1908 when they will get their next supply.

"Now let us cite a single illustration of molasses feeding in Louisiana and of why our distillers may have to go to Cuba for molasses. On a certain sugar plantation some eighty head of mules and horses have been fed on Bermuda and pea hay and molasses thoroughly mixed together with an allotment of two pounds of cotton seed meal per day per animal. This has gone on continually since the first of January and the animals have had no corn, oats or other food of any kind, except an occasional day in pasture on Sundays or when the lands were too wet to plow. Without a grain of corn or oats and no feed but molasses, cut hay and cotton seed meal, these mules and horses are now in better condition than are the mules and horses of any of their neighbors within twenty miles. They have been free of disease, have had no colic and no sunstroke. They consume by weight 2 pounds of cotton seed meal per day, by estimate fifteen pounds of molasses, fifteen pounds of cut hay and ten pounds of loose hay per day. The consumption of molasses and cut hay is increased with both items because of the mixing. The animals consume more molasses this way than when served liquid in open tanks, and apparently because of the chance it gives them to chew the hay while consuming the molasses. The mules rejected the cotton seed meal in the beginning but grew to like it and to seek for it as a German might for his favorite cheese. Let us hope there will never be any more molasses to give away, or even to sell under ten cents per gallon in Louisiana."

KEKAHA-WAIMEA DITCH ON KAUAI.

By J. S. Molony, Assoc. M. Inst. C.E.

Preliminary surveys for this ditch were made in August, 1905, with the object of determining the most feasible elevation and location for bringing the water of the Waimea stream on to the cane lands of the Kekaha Sugar Co.

The writer was appointed engineer in charge of the work and commenced the surveys for the ditch location about the middle of April, 1906. Contracts were let and the work of construction was begun two weeks later. The water was admitted at the intake July 15, 1907, fourteen and a half months after the start.

The Waimea river is one of the largest streams in the islands; it has a dry-weather flow of nearly 100 million gallons per day, which, until recently, ran to waste into the sea. A mile from the beach it splits up into two branches of about equal size—the Olokele and the Waimea streams.

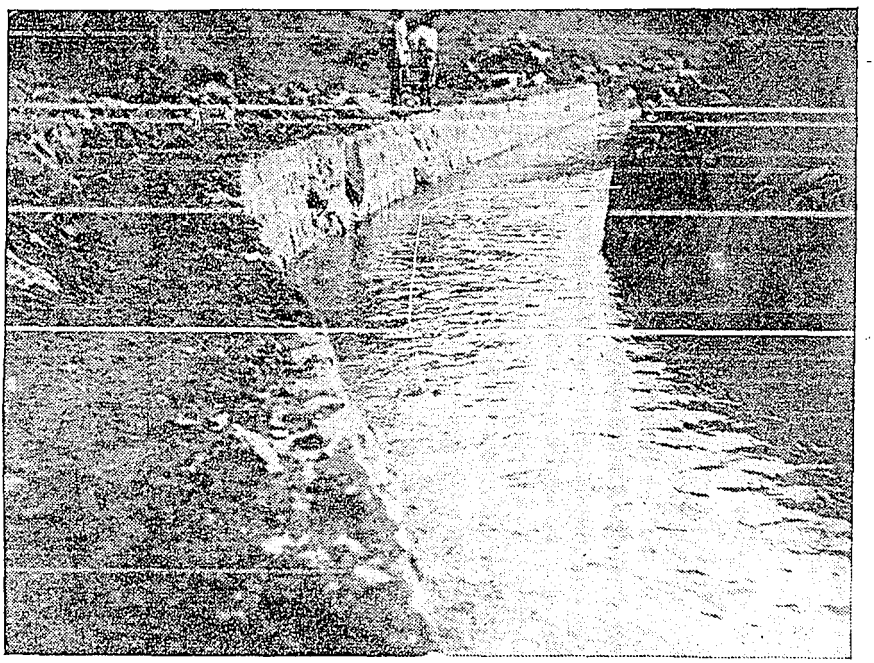
In 1903 Mr. M. M. O'Shaughnessy, C. E., built the famous Olokele ditch of 60 million gallons capacity which conveys the water of one branch, at 1075 feet elevation, to the Makaweli cane lands. About the same year Mr. E. Tappan Tannant, C. E., built the Waimea flume which withdraws eight million gallons from the Waimea branch, for the Waimea plantation.

The Kekaha-Waimea ditch, just opened, has its intake on the Waimea branch of the river at 550 feet elevation and eight miles up from the sea.

The intake is by means of a tunnel which enters a deep pool,

TUNNEL IN KEKAHA-WAIMEA DITCH.

below the surface; and the water is admitted through two grated openings, each five feet by six feet; no dam is required. Passing through a series of tunnels inside vertical palis 600 feet high, then by ditch through fields of loose rocks of great size, or by raised ditch fitting on to the ground, the water is led for four and a half miles to the edge of a plateau above the river. At this point it crosses the Waimea valley by means of an inverted syphon of steel pipe of 48-inch and 42-inch diameter and 2190 feet long, and delivers into tunnels 8, 9 and 10—350 feet above the Waimea flume.



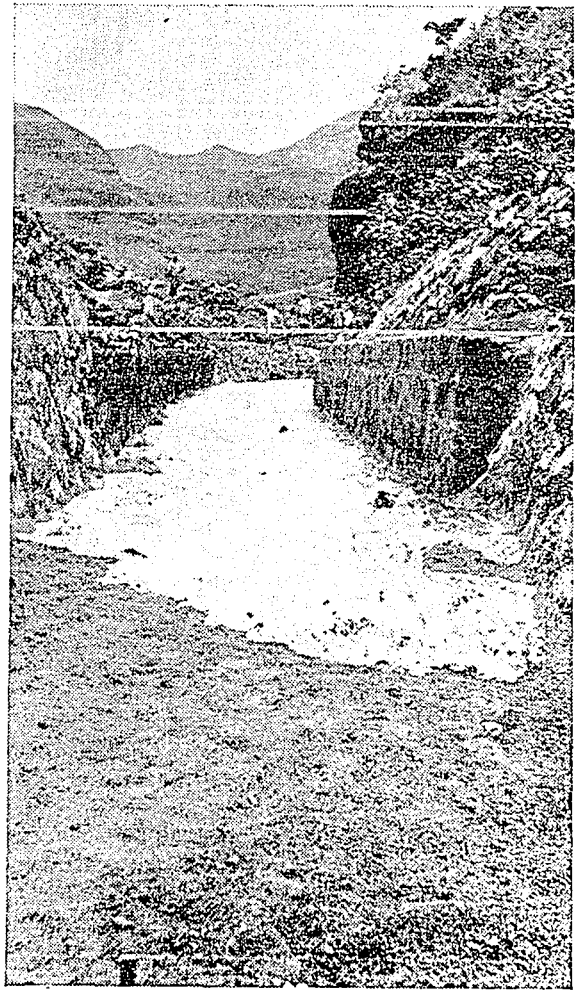
KEKAHA-WAIMEA DITCH—WATER IN FULL FLOW.

Emerging from here, the ditch traverses gently sloping ground, passes through tunnels 11 and 12, and reaching the open ground above the village of Waimea, it bends to the west and heads for Kekaha. Here the country is much broken by a series of rocky gulches, one after another: tunnels 13, 14 and 15, and two inverted syphons of wooden stave pipe, each 700 feet long and 40 inches diameter, are on this section.

This upper ditch is 16 miles long and ends at Waiawa gulch, above the residences of Mr. Augustus Knudsen and Senator E. Knudsen.

The tunnels are eight feet wide and six feet high; they have an

aggregate length of 8660 feet and they were driven, for the most part, through very hard rock: the ditch has a capacity of 55 million gallons per day above the syphon across the Waimea valley and 45 million gallons below: the size of the former being nine feet wide at the bottom and four feet six inches deep; and of the latter eight feet and four feet three inches. The surplus water will be turned back into the river from the syphon; yielding 750 horse-power without other expense than the cost of the machinery as well as supplying the needs of the taro and rice lower down the valley.



KEKAHA-WAIMEA DITCH—WATER JUST LET IN.

No flumes are used, except for a few gulch crossings. At Waiawa the water is dropped 280 feet to a lower ditch, nine miles long, that will convey it to Polihale--the end of the plantation—where the palis shut off the road at the Barking Sands.

The drop at Waiawa can be utilized for generating electric power for the plantation.

In the mauka section there was some heavy work necessitating considerable masonry and concrete; while makai the ditch was, for the most part, cut through solid rock with the floor and sides cemented afterward.

The water is now flowing to the cane fields through eleven miles of ditch; the remaining five miles are practically finished and will be in use in a few weeks.

About 600 men were employed. The features of the country presented great difficulty in the construction; yet, as no part of the ditch was more than ten miles from the plantation office, much assistance was given the ditch by the Kekaha Sugar Co.; and this, notwithstanding the heavy rains and freshets of the past winter and other setbacks, has largely contributed to the early completion of the work.

THE BEET SUGAR INDUSTRY.

The progress of the beet sugar industry in the United States is fully set forth by Mr. Charles F. Saylor, special agent, United States Department of Agriculture, in bulletin No. 84. The year of 1906 was the most successful year since the beginning of the industry in this country.

"We are now producing enough sugar (from beets and cane) in the United States to supply the population in the western two-thirds of our entire area, or enough to supply nearly one-third of the whole amount of sugar consumed in the United States. The beet crop has been bountiful in all sections of the country. Factories have received larger supplies of beets than at any other time, many of them more than it was practicable to manufacture into sugar. During the past year more plants have been built and considerably more capacity for manufacturing sugar has been installed than in any preceding year. The prospects at the present time are encouraging for 1907, and, in fact, the continuous development of this industry seems assured.

"To state in tons the amount of sugar produced suggests to the average reader an indefinite idea as to the real magnitude of the industry, but the statement that the population west of the Mississippi river is producing a surplus of sugar over and above its consumption conveys a startling fact which very few have realized."

Mr. Saylor estimates the production of beet sugar for the entire United States for 1906 at 1,037,300,000 pounds. The actual

returns for 1906 are 967,224,000, only 70,000,000 pounds, or about 7 per cent. short of the estimate.

There are now in the United States 64 beet sugar factories. Each of these factories has an official known as an agriculturist. It is part of his business to study the problems presented by the climate, soil and other conditions of his locality. It is his further duty after arriving at conclusions to promulgate them and to offer practical suggestions to the farmers interested in growing beets for his factory.

"One of the noticeable results of the sugar industry is its influence in increasing the crop resources of the various sections of the country. Probably the most noticeable effect of this phase of beet growing is to be observed in Wisconsin. In the country surrounding Madison about 12,000 acres of tobacco has been grown. In Rock County, surrounding Janesville, nearly a like area has been cultivated to tobacco for a number of years.

"During the four or five years beet growing has been in operation among the tobacco fields of Wisconsin this has proved the natural tendency. The beet sugar industry has introduced tobacco growing into a larger field than it had before. It has become more profitable to grow tobacco on account of the relation of the two crops. A similar condition prevails in some parts of Colorado. Lands producing potatoes profitable for a long while must be changed to some other crop and rested. They are naturally in fine condition for beet growing, which is therefore introduced, and the beet crop leaves the land again in a great deal better shape for potatoes. It is found in those irrigated States that they have more lands to grow alfalfa, potatoes, melons, wheat, and other cereals, from the fact that the sugar factory, on account of its superior capitalization, has increased the facilities, including labor, irrigation, rotation and trolley and railroad lines for shipping.

"The beet sugar industry not only increases established crop production, but introduces new crops adapted to the conditions, especially of our newer sections of the country now developing.

"From the inception of the manufacture of sugar from beets there has been a constant struggle for supremacy between the cane sugar interests of the Tropics and those producing sugar from beets in the Temperate Zone. At the present time they are pretty evenly balanced in this contest. According to Willett & Gray, the world's production of sugar for the last year amounted to 14,305,823 long tons. Of this, 7,144,377 tons were credited to beets and 7,161,446 tons to cane.

"From a plant yielding 6 to 7 per cent. of its weight in sugar, the sugar beet has been improved so that it will yield from 15 to 20 per cent., some individual beets going as high as 25 per cent. There is a marked tendency throughout the beet-growing districts of the United States year by year to increase the gen-

eral average of sugar contents. The custom of holding prize contests has encouraged the production of better beets. These contests are conducted by county and State fairs, sectional and national expositions, and business and trade organizations. The important points on which the beets are scored in these contests are sugar content, yield, shape, cost of production, time of planting and harvesting.

"The sugar content and purity of the beets are of the highest importance to the factory. If the purity is high, the expense of manufacture is considerably less. In many of our factories beets are bought on a sliding scale, or according to the sugar content and purity. In such cases the farmer benefits with the factory in the higher percentage of sugar and purity in the beet. In many other cases the farmer is paid a flat price per ton. Even in such cases he benefits indirectly by the higher sugar contents, because the factory can afford to pay more for beets if they are of better quality."

Conditions of the industry and its possibilities are outlined in detail, the author specifying the outlook by States. In 1906, there were 396,615 acres devoted to beet culture. Michigan had 16 factories in operation; Colorado, 15; California, 8; Utah, 5; Idaho, 4; Wisconsin, 4; Nebraska, 2; Arizona, Illinois, Kansas, Minnesota, Montana, New York, Ohio, Oregon, Washington, one each. In 1901 there were 36 factories operated, against 63, in 1906. Colorado, with its 15 factories, turned out 334,386,000 pounds of sugar, being much more than was produced in the 16 plants in Michigan, credited with 177,214,000 pounds.

It appears that the Western States, where irrigation is practiced, are better adapted to the beet sugar industry than the States farther east, where dependence for moisture is on rainfall only. The advantage of the west are, however, offset to some extent by the considerably lower cost of growing beets and by better markets and consequently higher prices for the product of the factories in the middle and eastern states.

Some idea of the magnitude of the beet sugar industry in the United States can be given by estimating the value of the beets sold by the growers to the factories and of the refined sugar placed on the market by the factories.

If we assume that the average price paid for beets in 1906 was $5 per ton, the total value of 4,236,112 tons of beets harvested is $21,180,560. If we estimate the value of the sugar at 4½ cents per pound, the 967,224,000 pounds of sugar manufactured was worth $42,525,080. Probably the assumed price both for beets and for sugar may be a trifle below those actually received, but these figures are sufficiently accurate to indicate the magnitude of the industry.

THE CHEMISTRY OF SUGAR CANE AND ITS PRODUCTS IN LOUISIANA.

This is the title of Bulletin No. 91, issued by the Agricultural Experiment Station of the Louisiana State University and A. & M. College, Baton Rouge, the data collected in it representing a summary of the work performed during the past few years in the sugar house and laboratories of the Sugar Experiment Station at Audubon Park, New Orleans, the same being compiled by Drs. C. A. Browne, Jr., and Prof. R. E. Blouin. The composition of the sugar cane in Louisiana is first taken up, and this is a matter of very general interest throughout the entire cane sugar world, as the fact that sugar cane, rarely reaching maturity in Louisiana, presents special difficulties in its final manufacture into sugar, and the extremely careful study that has been necessary to a thorough comprehension of these difficulties has been found to be of great service to the entire cane sugar producing world, even where they do not have the cold winters and incidental frosts that prevail in Louisiana. The cane sugar industry in Spain is carried on within the frost lines, as is also that of Queensland, Australia and, to some extent, that of Argentina. In these countries, however, they have very dry climates, as against our somewhat humid climate in Louisiana, and the ill effects of cold weather there are not nearly so great as with us. The varying weather conditions of Louisiana, as well as its varying soils, still further complicate the cane sugar problem, and the great work done by our Sugar Experiment Station during the last twenty-five years in dissipating some of these complications is recognized everywhere among industrial scientists as being of the highest value. Students of the industry everywhere will find this present bulletin one of the most complete that has ever been issued by the Sugar Experiment Station from the fact that it is a compilation of all of the scientific data secured during the investigations made at the station for now more than two decades.

The first data given is the approximate analysis of sugar cane, including its leaves, stalks, roots and seeds. Our interest is chiefly in the stalks, which, according to analyses made by Halligan and Agee, approximately contain 75 per cent. of water, 13.40 per cent. of sugar, 10.04 per cent. of fibre and, say, 1.56 per cent. of ash, fat, wax and nitrogenous bodies. The water content of the sugar cane is variable, decreasing as the period of maturity advances and depending also upon the wetness or dryness of the season. A generally recognized fact is uttered with the emphasis that it deserves, and that is that canes, after being cut, lose water rapidly from evaporation.

There is seemingly a corresponding increase in the solids in the juice, but analyses of juices from canes that have been long windrowed, or shipped considerable distances, frequently lead to erroneous conclusions regarding the sugar content. From these data the conclusion must be that sugar canes once cut should be manufactured into sugar with all possible speed.

The ash of sugar cane in Louisiana is found to vary widely, according to the variety of the cane, type of soil and manner of fertilization. Analyses made by Hall of the ash from the leaves, stalks and roots of D: 74 are given, and we quote the data as to stalks as follows: Potash, 38.23 per cent.; sulphuric acid, 18.47 per cent.; phosphoric acid, 5.27 per cent.; carbonic acid, 2.70 per cent., with silica, 15.70 per cent., magnesia, 5.73 per cent., lime, 5.19 per cent., chlorine, 4.52 per cent., with small percentages of soda, iron oxide, alumina and carbon.

The fat and wax of sugar cane has been carefully considered. Dr. Evans, who published his valuable work on the Sugar Cane over sixty years ago, referred to the studies of cane wax made by Avequin in New Orleans. Reference is now made to these studies and also to those of Dumas, who made a chemical study of Avequin's cane wax, and to Lewey, who repeated Dumas' work later on.

The nitrogenous bodies of the sugar cane, which in Louisiana amount to but .05 per cent., have been determined by analyses of the Louisiana purple canes. The derived data is stated to be subject to considerable variations, according to the age and variety of the cane, manner of fertilization and cultivation. The nitrogenous bodies are not distributed evenly throughout the stalk, the work of Beeson having shown a greater localization of albuminoids in the nodes and of amids in the internodes.

An interesting section is that discussion of the fiber of sugar cane, in which we get on somewhat difficult ground, from the fact that fiber determinations have been admitted by chemists generally to be of difficult attainment. The fiber of sugar cane is distributed among three principal tissues, the rind or shell, the pith and the fibrous vascular bundles. A mechanical analysis of Louisiana a purple cane gave 2.39 per cent. of pith, 1.81 per cent. of bundles and 5.51 per cent. of rind, a total of 9.71 per cent. of fiber. The analysis of the different tissues shows a comparative regularity, except as to the ash, which in the fibro-vascular bundles gives double the percentage of what is found in either the pith or the rind. Incidentally, reference is made to Beeson's analyses of nodes and internodes, by which it was found that the fiber of sugar cane is double in quantity at the nodes as compared with the internodes. Reference is made to the hydrolitic products obtained by digesting purified bagasse with caustic soda, in which it is found that a hundred parts of cane fiber with the protein, ash, fat,

etc., excluded, gave, say, 55 per cent. cellulose, 20 per cent. xylan, 4 per cent. araban, 15 per cent. liguin and 6 per cent. acetic acid. These data must be considered in the manufacture of paper stock from bagasse, as the pithy cellulose is very easily attacked by concentrated alkalis. Reference is made to the pectin, or gums, of sugar cane which escape into the juice during the milling process, and also to the various organic acids, some of which have not yet been sufficiently exploited. The coloring matter of sugar canes, including the chlorophil, which gives the leaf its green color, is said to be present to some extent in the stalk, as is also the red or purple coloring matter of the colored canes. Starch is found in the leaf of the cane and in traces in the green portions of the stalk, and it is doubtless one of the agents that renders the manufacture of green cane somewhat difficult.

The physiology of the growth and ripening of sugar cane is a line of inquiry that we shall hope to see materially advanced in the future. With such an enormous amount of work before it, the Sugar Experiment Station thus far has had its hands full of work to do, and its professors actually overworked in their various departments. More or less attention has necessarily been paid to the physiology of the sugar cane, and from this section of the bulletin we learn that during germination and for the first few weeks of its growth, the young sugar cane is entirely dependent for its supply of plant food upon the mother cane. This food supply is largely made of sugars and nitrogenous material. The sucrose of the mother cane undergoes a slow inversion, as is always the case in plants when this reserve material is being transported to points of growth. Juice from a sound mother cane that had lain in the ground two years at Audubon Park contained 1.40 per cent. sucrose and 0.91 per cent. of reducing sugar. From this it is seen that the process of inversion is one of long duration. This inversion of sucrose goes on more rapidly in the region of the bud and is due to the activity of an inverting ferment or enzyme developed during the process of germination. On Louisiana sugar plantations the plant cane fields at this writing are paler in color than the ratoon, or stubble, cane fields. This will continue until in mid-summer or, say, about July 1st, after which the plant canes have a deeper green color than have the ratoons. There is involved here some physiological problem that we have been endeavoring to solve, but without success thus far. It is to be presumed that the young plant canes, drawing their sustenance from the mother cane, will be unable to set up for themselves and draw sustenance from the soil until they shall have jointed and thrown out roots into the soil from the joints and thus secured their moisture independently of the mother cane. At the same time, the young ratoons, or stubble, cane are said to be drawing their supply of nutri-

ment from the stubbles of last years' cane crop. It is further asserted that the roots of these stubbles of last year's cane crops are dead and, necessarily, inactive. If this be the case, the entire supply of nutrition for the ratoon, or stubble, canes must come from the small piece of stubble of the last year's cane crop left in the ground. May we not inquire, then, why it is that the short pieces of stubble will give a deep colored ratoon cane, while a large mother cane will give only pale colored plant canes? Our bulletin says that as soon as the young cane has developed leaves and roots, it gradually ceases to be dependent upon the mother cane and is in position to shift for itself. We have thought that the young canes developed leaves a month or more before it developed roots, which can only come to the young cane after it has formed a joint. Anyway, this would leave the problem as to the difference in the color of plant cane fields and stubble cane fields still open.

One of the chief functions of the cane leaf is the formation of starch and sugar. The sucrose, or sugar, may be formed directly in the process of assimilation, or it may be derived secondarily from the starch, but neither the starch nor the sucrose remain as such in the leaf for any length of time, but are converted into reducing sugars and transported to points of growth and utilized in building up new tissue. This translocation and conversion goes on at night, as well as by day, the assimilative products which accumulate by day being in a large part removed during the night. Analyses of young canes showed 0.94 per cent. sucrose in the evening and but 0.54 per cent. in the morning, a transferrence of one-half the sucrose from the leaf during the night. These analyses were not carried through to the complete maturity of the canes, but illustrate the general character of the juice during the period of growth. There is a regular increase in the percentage of fiber and sucrose, but not in any fixed ratio.

The physiological role of the enzymes of the sugar cane are next considered. Though present in but exceedingly minute amounts, these ferments play a very important role in the physiological processes of the plant and require more than a passing mention. If the green tops of a sugar cane be well macerated, the juice expressed and treated with an antiseptic agent, such as chloroform or thymol, to prevent fermentation by yeasts or bacteria, it will be found that the sucrose content of the juice undergoes a gradual diminution, though no traces of micro organic life are evident, and that simultaneously with this decrease in sucrose, the content of reducing sugars increases. This is a well marked instance of the activity of the enzyme invertase, the presence of which was noted in the leaf of the cane. This enzyme occurs almost universally throughout the vegetable kingdom, especially in the green or growing

parts of the plants. This invertase has a very practical industrial bearing outside of its physiological importance. The gradual falling off in sucrose content of sugar cane which has been windrowed for any length of time is due very largely to the spontaneous inversion. If the green tops of the cane are removed at the time of cutting, the loss of sucrose is much less evident. This can easily be seen by reference to the experiments carried on at Audubon Park in 1893, in which several lots of cane were windrowed and one-half of each lot had the tops removed and the other half retained them; otherwise all the conditions were the same, and at the end of a month the rest of the tops were removed and in lot one the early topped cane indicated 13.3 per cent. sucrose, the other 12.1 per cent. In lot 2 the early showed 12.8 per cent, the other 11.5 per cent. In lot 3 the early 13.5 per cent., the other 12.6 per cent. Lot 4, the early showed 13.7 per cent., the other 11.8 per cent., and in lot 5 the early showed 12.8 per cent. sucrose and the other 10.7 per cent. The loss of sucrose due to spontaneous inversion is very evident and is attributed very largely to the diffusion of the inverting enzyme from the green tops in the stalk. The inversion of the sucrose naturally causes an increase in the glucose content, though this increase is not proportional to the loss in sucrose. This discrepancy is probably due to the destruction of the glucose from respiration in the leaf. The experiments show conclusively that the vital processes of the cane go on, even after it is cut. It must not be forgotten that there is also a slow inversion of sucrose in canes that are windrowed with the green tops removed, though this inversion is attended by the concentration which the solids of the juice undergo from evaporation.

A marked peculiarity of sugar cane juice, as of all vegetable juices, is the rapid darkening in color which takes place immediately after expression. This darkening is much more evident within the body of the cane, especially in the region of the eyes and growing parts and when its tissues are laid open to the air. We have here an evidence of another enzyme belonging to the class of oxydases. The intense blue coloration which the tissues and juices of plants take on with tincture of guaiac is ascribed to an oxydase. The decomposing action which plant extracts exercise upon hydrogen peroxide discovered by Schoenbein has been similarly explained, though Loew attributes the latter phenomenon to an especial enzyme, catalase, and Pozzi Escot to a new class of ferment called reductases. Juice from sterilized cane exhibits none of these reactions named.

If certain polyphenols, such as hydroquinon, or pyrogallol, are added to fresh cane juice, a rapid oxidation of these compounds is produced, with an intense darkening of the juice. The latter takes on at the same time a peculiar odor, due, prob-

ably, to the formation of a quinone body and, what is more remarkable, acquires a germicidal property which, in the case of hydroquinone treated juice, insures its preservation for weeks. Sterilized juice shows no change in color and develops no germicidal properties with any of the phenol bodies named. It is thought, on the other hand, that cane juice does acquire for a time certain germicidal characteristics and that it is within the body of the cane itself that this germicidal action is most evident, as when the cellular tissues are bruised. If two stalks of cane are taken, one raw and one sterilized, and punctured with a knife, at the end of a few days a marked difference will be noted in the wounds. That of the raw cane will be discolored, but free from fermentation. The wound in the sterilized cane will not be discolored, but will be badly infested with bacteria and moulds. When the sugar cane is attacked by the borer, or beetle, the pathway of the insect is much discolored, but we notice no inroad or organisms into the sound tissues. The live plant appears to protect itself against the invasion of microscopic parasites by forming toxic products. In case the sugar cane is killed, as sometimes happens during a freeze, this power of protection is lost. The formation of toxic products does not go on, hordes of bacteria invade the cane and, finding no resistance, start a fermentation which soon renders the cane worthless for milling. If these toxic products are so deadly to micro-organic life, why do they not react unfavorably upon the cane itself? It is here that the catalyzing enzymes perform their function. For should the toxic oxidation products diffuse inward beyond the points of their formation, they are at once reduced and thus exert no action deeper than the exposed surface.

In conditions affecting the composition of the sugar cane, reference is made to the influence of climatic conditions and analyses of juice made at different periods in the years 1903 and 1904, quite dissimilar seasons, illustrate this fact. The conditions for 1903 were very adverse to the growth of the cane, yet hastened the ripening to an extent rarely attained in Louisiana. On the other hand, the unusually warm weather in the fall of 1904, together with favoring rains, promoted the growth of the cane even into December, but retarded the ripening. The tonnage was high, but the sucrose content low. These conditions naturally made themselves very noticeable in the sugar house, owing to the much lower purities of the juices and the relatively large amount of water requiring evaporation.

The variety of sugar cane seems also to have an important bearign upon its composition. At the period of the most rapid growth, say, the middle of August, it was found that D. 74 cane gave a sucrose content of 4.88 per cent., against Louisiana purple of 2.35 per cent., or practically two for one. Conditions of cultivation have a marked influence upon the composition of sugar cane. Good tilth and thorough cultivation favor the growth of the cane,

whereas a poor condition of the soil has the opposite effect. Incidentally, it is stated that in the tests of individual canes in the various experiments made at Audubon Park, first year's stubble averages about 80 per cent. of the weight of plant cane and second year's stubble about 70 per cent. The stubble canes are richer in fiber and sucrose than the plant cane, the second year stubble exceeding the first in this respect. A physiological explanation for these differences is given. In the stubble cane we have a partially dwarfed condition, and according to a well established law, when growth is checked maturation is hastened. Exactly the same effect is produced by the non-fertilization of cane. Canes grown upon non-manured plots at the sugar experiment station averaged much less in weight, but were higher in sucrose than canes which have been fertilized. The stunted growth of our stubble cane is due very largely to the inability of the crop to secure a sufficient supply of plant food, particularly nitrogen, and an indication of this is shown by the deficiency in the juice of the stubble cane in mineral and nitrogenous ingredients. An inspection of the analyses will show this clearly.

The influence of soil and fertilization are quite marked upon the composition of sugar cane. It is well known that the taste of syrup or molasses from salty cane fields gives evidence of the floodings by salt water. The marked effect of fertilization and non-fertilization upon the composition of sugar cane and its juices is also well marked, but this subject requires so much space to treat it adequately that it has been reserved for a separate bulletin.

The composition of sugar cane juice and methods of extraction has a separate chapter. Theoretically the juice of the cane is simply a solution of the soluble ingredients, sugars, salts, acids, etc., in the cell water. The juice as expressed from the mill, however, contains in addition to the soluble matter a small amount of the insoluble ingredients of the cane, such as particles of fiber, bagasse, fat, albuminoids, dirt, etc., in suspension, or in emulsion, so that a filtration of the juice without previous clarification is almost an impossibility. Complete analyses of cane juice and of the ash of cane juice are given and it is a notable fact that while all the analyses show a certain uniformity, the difference in composition between the ash of the Louisiana canes and of the new seedlings is well marked. The various factors previously enumerated, climate, variety, cultivation, fertilization, etc., which affect the composition of the cane as a whole, naturally affect the composition of the juice. There are several factors, however, which have an influencee upon the juice and first among these is the fact that the top of the cane contains less sucrose and more of the solids not sugar than the lower portions of the stalk. The manner of topping the canes, whether low or high, has considerable effect upon the composition of the juice. Analyses made by Agee and Hall at Audubon Park, giving the composition of the juice from the different parts of the cane, show wide differences therein, the

lower joints containing two or more times as much sucrose as the top joints, and this where the canes analyzed were cut in accordance with the Louisiana usage, that is, topped not higher than the last red joint. The difference in composition of cane juice from the nodes and the internodes, hereinbefore referred to, was studied by Beeson at Audubon Park and the results given in a former bulletin. It is incidentally stated that the juice from the fibro-vascular threads, or bundles, is frequently forced out from the end of the cane, when it passes through the rollers of the mill, and analyses show it to be almost completely deficient in sugar. This phenomenon has been very clearly explained by Director Dodson, who has shown by numerous experiments that the juice thus expressed from the ends of the cane is simply a solution of mineral matter from the soil on its way through the vascular tubes to the leaves. Though it travels very near the tissues rich in sugar, it contains but little organic matter of any kind.

The composition of cane juice varies according to the method of extraction and the mechanical impurities introduced into the juice by its extraction with cane mills will vary according to the pressure applied. Accordingly, it is expected that juice of a higher purity should come from the first mill, or crusher, than is the juice that comes from the last mill. This is exactly the result of practical experience, as determined by experiments made at Audubon Park, in which it was found that with juice extraction by the first mill of 64.50 per cent., by the second mill of 5.50 per cent. and by the third mill of 2.13 per cent., a total extraction of 72.13 per cent., the purity of the juice from the first mill was found to be 84.07 per cent., of the second mill 78.15 per cent. and of the third mill 77.39 per cent. With each pressure the purity decreased, but so did the glucose, also albuminoids, gums and ash showed a marked increase in the juice from the later pressures. It was further found that if water or steam be employed for saturation in connection with the milling, the percentages of impurities in the juice will be still further increased. A considerable difference is noticed in the composition of juices as obtained by the mill and by the diffusion battery, and in experiments referred to the purity stood at 80 per cent. in mill work and 81.5 per cent. in diffusion.

The clarification of sugar cane juice, in many respects the most important operation of the sugar house, consists in the removal, as far as practicable of the varying amounts of organic and inorganic impurities of the juice, and especially those of a mechanical nature, such as fat, wax, fiber, soil, etc., which latter may be eliminated entirely. Other impurities, such as the ash, albuminoids, acids and gums, even in the best of our present processes of clarification, are only partially removed while other undesirable elements, such as reducing sugars and amids are not at all precipitated by the ordinary clarifying agents employed. The work of clarification affects the composition of the cane juice by the removal of certain ingredients, either in whole or in part, or by the

transference of certain of these constituents into other forms. The sucrose, for example, may be partially inverted, the glucose changed into acid products, or the amids and the albuminoids converted into substances of a different character. The chemistry of the different processes of clarification is therefore exceedingly complex and the character of the changes which take place is in many instances very hard to follow, owing to our imperfect knowledge of many of the products formed. In the present study of clarification the action of heat upon the juices, the action of lime both alone and in connection with sulphur phosphoric acid and carbonic acid and certain special processes, such as superheating and electric clarification are discussed. Heat alone for clarification is never employed in the sugar houses, but in the manufacture of cane syrup heat is often the only means employed since a partial inversion of sucrose for this purpose may be even desirable to prevent crysallizaion. It was shown by Agee and Hall that 0.23 per cent. of impurities in the juice from striped cane are removed by the simple process of boiling and 0.45 per cent. of the impurities are similarly removed from the juice of D 74. Two general systems of clarification are referred to, the one called alkaline clarification and the other acid clarification. In the former the juice is first treated with milk of lime and in the latter it is treated first with sulphurous or phosphoric acid. It is presumed that with either treatment the juice is brought back to neutrality before boiling, so that these classifications are only preliminary to the general clarification. Lime, because of its cheapness, availability and general excellence, has been used from the earliest times for clarifying cane juice. Its first action consists in neutralizing the organic acids and if heat be then applied no inversion of sucrose takes place, the albumen of the juice is coadulated, the sulphates and phosphates are thrown down as insoluble lime salts, and the bases, iron and alumnia precipitate. The separation of these impurities exerts also the mechanical purification, the fat, wax, fiber products and of soil, and the portion of the gums being removed by the formation of a floculent precipitate. An excess of lime in clarification is to be avoided, because of its destructive action upon the constituents of the juice. The reducing sugars are specially attacked and the resulting dark color injures the appearance of the products. Lime salts increase the viscosity of the juice, thus retarding the work of evaporation. The whole matter of cane juice clarification is such a recondite one that all of those interested will do well to provide themselves with this bulletin and make the matter a careful study, as many valuable data are given covering all the various methods of clarification and their effect upon the final products in quality and in quantity.

The bulletin ends with a schematic tabulation of yields and compositions of sugar house products, taking a million pounds as the basis of the scheme giving the results in sugar house pro-

ducts from poor juice, from an average juice and from good juice, stated in terms of raw juice, sulphured juice, clarified juice, syrup, first masse cuite, first sugar, first molasses, second masse cuite, second sugar, second molasses, third masse cuite, third sugar and third molasses. This whole bulletin is a veritable vade mecum for the sugar planter, field manager, sugar house superintendent and sugar boiler.

LABOR IN EUROPE.

WAGES AND FOOD PRICES IN FRANCE.

Consul Louis Goldschmidt, of Nantes, under date of January 28, transmits the following reports covering the wages and food prices in Nantes, which, the consul says, may be considered a city of average prosperity, as compared with other cities in France and in Europe generally:

Considerable has been published lately in America concerning the increased cost of living and the comparative pay of labor in the United States. In some cases the writers have tried to demonstrate that it is only in the United States that the cost of articles of daily consumption has increased to any considerable degree. Statements are also frequently made to the effect that, although the wage of the laboring classes abroad is usually lower than the wage of the same class of labor in the United States, nevertheless living abroad is so much cheaper that the laboring class is just as happy and just as prosperous as the American laborer.

CONDITIONS OF LABOR.

Taking all these facts into consideration, concerning the condition of labor here as compared with labor in the United States, one may say that labor here has not reached the degree of prosperity that labor has reached in the United States, nor in any way approaching thereto. A great deal has been done and is being done in the way of organizing labor, and this will undoubtedly result in much good for the laboring classes here. Their condition is much better than it was a few years ago, and it is tending to constant amelioration as regards wages, but this condition can not be compared with that of the laborer in the United States, and when the cost of living for laborers in Europe is compared with the cost of living in the United States he fact should be taken into consideration that the laborer of Europe does not live as well as the laborer in the United States, nor are his requirements as many.

Many things are considered necessities to the laborer in the United States which would be luxuries to the laborers of Europe.

In Europe the laborer expends much less than in America and in spite of this lives comparatively happy, because he does not know or feel the needs of all that enters into the daily life of the American laborer. The wages here do not permit of extravagance, and comparison of the condition of the laborer here and in the United States can not be made without coming to the conclusion that the laborer in the United States lives much better than here. Everything in the line of necessities for living comes high in Europe; the only commodity that is really cheap here is the price of labor.

MOLASSES THE MOST VALUABLE BY-PRODUCT.

One of the principal by-products resulting from the different processes for the extraction of sugar from the beet is molasses. During the campaign of 1904-05, when 1,605,438 tons of raw beet sugar were produced, the output of this by-product was 366,860 tons. Taking the present price at the factory of 71.4 cents per 110.2 pounds, or $14.30 per ton, the value of the molasses by-product was about $5,250,000. In Germany, where the prices of all kinds of fodder are comparatively high, the farmers employ the refuse molasses as one of the component parts of their cattle feed.

It is either fed directly to the animals in a thinned condition or mixed with ground palm seed, rape seed, cocoa or peanut shells, dried brewers' grains, fresh blood and with other by-products or wastes from different agricultural industries. It is sometimes used with peat, which has been pressed and the beet cuttings. They are highly prized by the German farmer as an excellent fodder for his cattle, which can be preserved for use throughout the winter. When waste molasses is added to the dried pulp, the food is rendered more palatable for the animals, and, being fed on the farm, the potash of the syrup is retained on the premises and restored to the land in the form of stable leachings and manure. These products in Germany are known under the name of "schnitzel."

From 40 to 50 per cent. of the wet schnitzel is usually returned gratis to the farmers who furnished the beets, the remainder either being sold at the factory for from 2.25 to 2.50 cents per 110 pounds or is used by the factory owners for their own farm purposes. The neighboring farmers store it in their silos. The schnitzel is also dried at the factories in special drying apparatus.

SUGAR SCHNITZEL AND THE TOPS.

The schnitzel resulting from the Steffen Bruh process of extracting sugar, called sugar schnitzel, is attracting considerable

attention among the German farmers. Its large sugar percentage makes it exceptionally good fodder for horses and for fattening cattle and pigs. The beet leaves and tops are also utilized by the German farmers as food for cattle. When fresh, however, owing to the oxalic acid contained in them, they are apt to have great purgative effect on the animals. In some cases, it is found by experience to be not only a good vehicle for carrying the molasses, but the chemical properties of the peat act as a preventive of the evil effect of the molasses, which is apt to produce diarrhoea in animals if not fed with caution. The proportion of molasses should be from 35 to 40 per cent., the exact amount to be absorbed being determined by experiment. A mixture containing not more than 40 per cent. of the syrup, if not exposed to dampness, may be stored for several months without deterioration. If, however, there is more than 40 per cent. of molasses in the mixture, even if the moisture is driven off by the heat, the resulting compound will be affected by the humidity of the air. A durable food mixture may be obtained by using beet pulp with the molasses. Fresh dried beet pulp which has been well pressed out and its sugar contents exhausted, is mixed with molasses in the proportion of one part of the syrup to two to three parts of the dried pulp. By the aid of a kiln-drying process any moisture remaining in the mixture is driven off, and the resulting product may be stored for years with but little danger of being affected by atmospheric conditions.

Owing to its high price, due principally to its increasing demand as a food for animals, molasses is comparatively little used in Germany at the present time by the distilleries, as alcohol made from the sugar by-product cannot compete in price with the potato alcohol. Distilleries not connected with farms no longer receive bounties. The German molasses distilleries produced, during 1903-04, 2,450,000 gallons of alcohol, a small quantity when compared with the average annual production of potato alcohol of about 80,500,000 gallons.

MOLASSES HAS MANY USES.

Molasses is employed in comparatively small quantities in the manufacture of brewers' yeast, dyes and the dyewood extracts, shoe polish, chicory, table syrups, ordinary candles, etc. The increasing use of aniline colors for dyeing purposes has greatly reduced the consumption of molasses in the manufacture of the vegetable dyes. Formerly larger quantities of the crude syrup were employed in making shoe blacking, but the great and continually increasing competition met with in the use of shoe dressing and creams has considerably lessened the amount of molasses consumed for this purpose.

Molasses is also employed in Germany to some extent in the manufacture of chicory. The finished product, sold under the

trade name of "Kaffee surrogat," has a market value at the factory of $8.81 per 220.46 pounds wholesale, or about 4 cents per pound. The processes, mixtures, etc., in which molasses is used in the industrial arts are the results of costly experiments extending over many years.

The spent pulp (scheideschlamm) and the mud remaining after washing the sugar beets are good fertilizers, especially for use in light soils. They are either given gratis to the farmers who supply the beets or sold at the factories. The prices of the spent pulp range from 19 to 24 cents per 20.46 pounds and the earth from one-half to seven-tenths of a cent. A part of the refuse liquor from the extraction of sugar from molasses is worked up into raw potash (schlempekohle), which is either sold to chemical factories, such as that at Dessau, to be manufactured into commercial potash or to farmers as a fertilizer, and a part is delivered in its liquid form for use on the neighboring farms. The lime precipitates (scheidekalk) are also sold as fertilizers for prices varying from 2.4 to 8 1-3 cents per 110 pounds. It has been found that when beets are diseased, owing to the presence of injurious bacteria, the mud containing these bacteria is apt to infect the fields upon which it is used as a fertilizer. An efficient method of sterilizing the mud not having as yet been found, although many experiments in this line have been made, care should be taken in the use of this fertilizing material.—*Kuhlows.*

JAVA'S SUGAR INDUSTRY.

For some time past the attention of the sugar world has been fixed on the development of Cuba. As well from the importance of her existing production as from the vast prospects of expansoin, Cuba merits careful consideration. There are, however, other cane sugar producing countries which deserve the same attention; of these Java is second to none. A study of the Java sugar industry is of interest, not only on account of its rapid growth within the last dozen years, but also and to a greater degree on account of the remarkable extent to which it has been aided by technical knowledge and skill, and of the extremely low net cost of production which is the rule. Viewed from the point of view of the world's price, we have here a factor of no small importance to consider.

The sugar production of Java for the last 11 years has been as follows:

	Tons.
1896	534,390
1897	586,299
1898	725,030
1899	762,447
1900	744,257
1901	803,735
1902	897,130
1903	931,286
1904	1,055,043
1905	1,039,178
1906	1,048,275

We see that the last annual production only yielded an increase of 9,097 tons, as compared with the previous year. After having roughly doubled between 1896 and 1904, the production has remained practically stationary since the latter year. Does this imply that the limit has been reached?

Having regard to the number of factories at work, the extent of Java's sugar production is an ample testimony to the highly concentrated system in vogue, a system which contributes largely to the reduction in general expenses and in the net price of the finished product. In 1906, 175 factories produced 1,048,275 tons of sugar, or an average of 59,900 sacks (of 100 kg.) of raw sugar per factory. In 1905 the average for 172 factories was 60,000 sacks, and in 1904 for 176 factories 59,950 sacks. Nevertheless as compared with some other sugar countries, Java's figures are by no means exceptional. In 1905-06 the mean output per factory in sacks of 100 kgs. was: In Cuba, 71,000 sacks; in Denmark, 95,000 sacks; in Holland, 73,200 sacks; in Austria, 72,000 sacks; in Germany, 63,000 sacks; in France, 37,000 sacks; in the United States (beet sugar), 53,000 sacks.

As to the area under cultivation in Java, Mr. Dickhoff estimated it in December last as 113,351 hectares (279,977 acres) for 1907 as compared with 110,463 hectares (272,843 acres) in 1906, and 105,393 hectares (260,320 acres) in 1905. The area under cultivation is therefore increasing from year to year.

And this cultivation, to judge by the results, is of the most perfect kind. In 1905 the yields of cane per hectare were: Western Java, 96,169 kg.; Central Java, 91,566 kg.; Eastern Java, 96,256 kg., or an average for the whole island of 95,038 kg., as compared with 94,777 kg. in 1904. The highest individual figure yet achieved was in 1903, when 101,826 kg. was obtained. This is a case of intensive cultivation in the truest sense of the term, and these high yields have a great deal to do with the incredibly low net cost of production.

The output of the factories as regards quality has also undergone a great change within the last ten years. In 1896, 8,282,351 piculs of first jet sugar and 740,363 piculs of "sack" or low grade

sugar were produced. In 1905 the respective figures were 16,447,-513 piculs and 756,459 piculs, showing that while the output of best sugar has doubled, the amount of low grade sugars turned out has not increased at all.

Java's yield per cent. on cane expressed in raw sugar is 10.5. Compared with this Germany yielded in 1905-06 15.28; Austria-Hungary 15.27; France 13.19; Java is, however, ahead of Cuba which, the same campaign, obtained but 9.86% of sugar on weight of cane.

But this seeming inferiority of Java when compared with Europe is more than compensated for by her greater cultural yield, inasmuch as her output of sugar per hectare far surpasses that of any European country.

In 1905 the average extraction of sugar per hectare was 10,078 kg. and 46% of the factories exceeded 10,000 kg., the highest individual production being 13,571 kg. In Europe the maximum yield in 1905-06 was obtained in Germany and amounted to 5,096 kg. For the rest of Europe the average was no more than 3,679 kg.

As showing the economy of production, the following figures will be found of interest.

One factory in 1905 worked up 1,118,016 piculs of cane (1 picul =61.76 kilos or 136.16 lbs.) and extracted 115,824 piculs of first jet sugar at a net cost per picul as follows:

	1905 Florins.	1904 Florins.	1903 Florins.
Staff expenses	0.69	0.64	0.72
Planting	1.85	1.81	2.10
Transport of canes	0.57	0.52	0.64
Heating and lighting	0.05	0.04	0.03
Manufacture of sugar	0.12	0.09	0.12
Packing	0.23	0.21	0.20
Transport and delivery	0.36	0.33	0.31
Various	0.27	0.29	0.21
Various purchases	0.04	0.04	0.04
Maintenance	0.19	0.13	0.13
Extraordinary expenses	0.05	0.08	0.02
Interest	0.13	0.04	0.17
	4.55	4.22	4.68
Francs per 100 kgs	15.47	14.34	15.91
Per cwt.	6s. 4d.	5s. 10d.	6s. 5d.

In 1905 this particular factory obtained 7.45 florins per picul for its sugar as compared with 6.59 fl. in the preceding year. This gave a profit of 2.90 fl. and 2.37 fl. respectively, or 9.86 fr. and 8.06 fr. per 100 kg.

Another factory with a smaller output gave the following figures of cost of production: 1905, 5.73; 1904, 5.40; 1903, 4.89 florins per picul. The selling prices for those years have been 7.77, 6.36, and 6.18 fl., the profits were respectively 2.04, 0.96, and 1.29 florins per picul.

A third factory had the following results:

	1905 Florins per picul.	1904 Florins per picul.	1903 Florins per picul.
Factory expenses	4.91	4.49	4.97
Selling price	7.14	6.59	6.10
Profit	2.23	2.10	1.13

A fourth factory in 1905 spent 5.22 fl. in working expenses, sold its sugar at 7.02 fl. and thus made a profit of 1.80 fl.

These factory results are the outome of perfect cultivation of the cane and unsurpassed factory management, for which qualities Java is rightly famous.

A year ago a proposal was made to establish a manufacturing tax in lieu of the existing export duty. In spite of the protest raised by the manufacturers, it was finally adopted by the authorities and received the assent of the law. This new tax is collected from all factories of a capacity of 1,000 piculs and upwards. It is based on the net profit, that is on the difference between the cost of production and the selling price of a picul of first jet sugar, "sack" sugar being calculated as half the value of first jet. If no profit is shown, then the tax is not collected. In amount it varies from 0.50 cents for a profit of 0.25 fl. per picul to 24 cents for a profit of 4 florins. It came into force in January, 1906, and was levied on the whole of the sugar from the previous crop, which had by the way obtained specially good prices.

The following table shows the exports of Java sugar for three years in metric tons:

	1905 Metric Tons	1904 Metric Tons	1903 Metric Tons
Holland	680	5,756	1,733
England	29,728	70,797	21,643
France	7	.....	44
Europe	76	8	16
United States	83,385	263,132	185,489
British India	105,544	109,556	59,861
Singapore	52,664	45,384	48,678
Hongkong	248,007	176,906	240,026
China	14,833	2,852	6,564
Japan	138,555	144,551	137,140
Australia	18,036	14,268	67,369
In transit	.....	4,176	39,640
In transit (Portugal)	.....	.....	1,341
In transit (Port Said)	198,054	183,414	59,456
Other countries	60,826	30,724	1,703
Totai	1,050,395	1,051,524	870,703

It will thus be seen that Java's best customers are British India, Hongkong and Japan. The exports to Europe have been of comparatively small importance. The State railways grant special low tariffs to those factories which send their sugar entirely by rail to the port of shipment. The cost for a wagon-load of 8 metric tons is 9 florins per kilometer, or 6 florins for 180 kilometers. Cheaper classes of sugar obtain still lower rates.—*Abridged from the Journal des Fabricants de Sucre, for The Sugar Cane.*

NOTES.

CHINA, YANGTZE PORTS, custom-house report, 1906. Perhaps the most conspicuous article on the import list is sugar, which, with an importation of all kinds amounting to 1,125,000 piculs, exceeds the preceding year's import by over fifty per cent. Strong rivalry has arisen between sugar from the refineries in Japan and that from refineries in Hongkong. In July, 1906, a Japanese committee met the Chinese sugar brokers of Chiukiang and placed before them samples of sugar comparing favorable in color, taste and smell with other sugars on the market. These samples were admitted to an European expert who pronounced them to be extracts from Java cane, of which Japan is now importing considerable quantities. It seems probably, however, that Japan would also use a large proportion of Formosan cane in her refineries. In August, 1906, they placed about 12,000 bags of refined sugar on the market to compete with the produce of the Hongkong refineries at the followig prices for similar grades:

Japanese—Tls. 6.10 per picul,
Tls. 5.90 per picul,
Tls. 5.70 per picul; against
Hongkong—Tls. 6.15 per picul,
Tls. 5.95 per picul.
Tls. 5.70 per picul.

In December, 1906, these prices had fallen to:

Japanese—Tls. 5.35 per picul,
Tls. 5.30 per picul,
Tls. 5.15 per picul; as against
Hongkong—Tls. 5.55 per picul,
Tls. 5.35 per picul,
Tls. 5.10 per picul.

The Chinese have found by experience that the Japanese sugar under storage deteriorates rapidly in appearance, taste and smell, indicating a want of knowledge in the refining process. With the advantage of importation in subsidized steamer lines and, it is said, of bounty fed factories, the competition is likely to be main-

tained. The Swatow sugars though dearer, being hand refined, are sweeter and for sweet-meat making are not likely to be displaced, as one catty is equal to one and half catties of foreign refined sugar.—*The Supreme Court and Consular Gazette, Shanghai.*

FORMOSA.—Formosan sugar once enjoyed a considerable market in China and Japan, but, as the result of competition with Dutch sugar (Java) and European beet sugar, its production for a time stood still. In 1898 a special sugar bureau was established under the supervision of Dr. Nitobe, a leading authority on agricultural economics. According to his investigations, Formosa will be superior as a sugar field to Hawaii. Cane cuttings from Hawaii have been brought into the island and planted in the experimental garden, and several American crushing mills have been imported. There are 1149 native manufacturies, besides two Japanese factories which are doing business on a large scale and which enjoy a government bounty. The Japanese, who annually spend over 15,000,000 yen (7,500,000 U. S. dollars) for foreign sugar, are very anxious to develop their colonial product.—*Sei i Hishida,* Columbia University.

QUEENSLAND NOTES.—Sugar production looms so largely on the industrial life of Queensland that the annual report of the government statistician on the season's production is always full of interest. In June, 1907, only Mr. Weedon issued the report for 1906, which shows that the area cultivated was 133,284 acres, of which 98,194 acres was crushed, for a yield of 184,377 tons sugar. It took 9.38 tons of cane to produce a ton of sugar. The amount has steadily risen, the decline in the quality of the sugar being attributed to excessive moisture in the good seasons. The richest cane was produced at Ayr, where it took only 8.31 tons of cane. The government statistician shows that bonus to the amount of £272,038 or $1,360,190 was claimed on 1,197,435 tons of cane grown with white labor. The amount invested in the sugar industry included £1,881,304 or $9,406,520 for machinery and £301,092 or $1,505,460 for land and premises. These works, 57 in number, employ 3,221 hands. On December 31, 1906, the State had a sum of £514,086 or $2,570,430 invested in the industry by advance. A sum of £34,163 or $170,815 had been written off the indebtness during the year. It was shown that the consumption of sugar in the Commonwealth was 187,143 tons, being slightly more than the production of Auckland.

The heaviest and most powerful cane crushing plant in Australia has just been completed by the Bundaberg Foundry Company, Limited, at Bundaberg, Queensland. Practically the whole of the staff connected with the manufacture of the above plant, including the manager, have acquired their experience and knowledge of engineering in Queensland, and the majority of the

tradesmen employed have served their apprenticeship with the enterprising firm. This contract was let by the Millaquin and Yengarie Sugar Company in August last year (1906), since which time the whole of the work has been designed, planned, manufactured, and it is now ready to start crushing.

Opening of the grinding season. Crushing commenced at the Colonial Sugar Refining Company's mill at Childers, June 29, 1907. The men working in the gangs appear to be very superior to the class of labor that usually drifts into the district during the grinding season. Many of them arrived by rail from the south. Very few of the swaggie variety signed on. Hundreds of men are camped about the district waiting for work. It is anticipated that there will be a considerable waste of cane during the early period of the crushing, as, owing to the unusual mildness of the season, the crop has not matured, and consequently a considerable amount of "soft stalk" or "top" will have to be cut off, which would otherwise have gone to the mill. A few weeks of cold, dry weather would be welcomed by the cane growers, especially those who sell their crop by the density (Brix, Beaume, Total solids in the cane juice, the specific gravity of the cane juice) system.

One thousand Spaniards engaged. One hundred and seventeen Spaniards out of 1,000 engaged for work on the Colonial Sugar Refining Company's Queensland plantations passed through Freemantle (Gerth), Westralia, June 25, 1907. They are natives of Catalonia (North Spain). It is stated that a man named Ferrer, acting for Mr. T. Hughes, Barcelona, province of Catalonia, Spain, attorney for the Colonial Sugar Refining Company, Limited, has induced over 1,000 natives (Spaniards), principally town-breed, to sign agreements to work for the company on such plantations as they may decide.—From the *Queenslander.*

Brazil Seeking Japanese Laborers.—Mr. Irving B. Dudley, minister to Brazil, reports that special effort is being made to induce the coming of Japanese labor, and that it is largely to this end that a subsidy is offered for the establishment of a regular line of ships between Rio de Janeiro and Japan. Mr. Uchida, who presented his credentials as Japanese minister to Brazil on June 3, in the course of conversation declared that in the consummation of these proposals is to be found the principal aim of his mission. The new steamship line, according to Minister Uchida, will be in operation as soon as arrangements can be perfected, and will probably touch at the west coast ports of Ecuador, Peru, and Chile, and passing through the Straits of Magellan visit Buenos Ayres, terminating the voyage at Rio de Janeiro. The purpose would be to bring to Brazil in these ships Japanese coolies to engage, under properly safe-guarded contracts, in rice growing, and, secondarily, in other productive work.

Sugar Plantations, Cane Growers and Sugar Mills.

ISLAND AND NAME.		MANAGER.	POST OFFICE.
OAHU.			
Apokaa Sugar Co.	*	G. F. Renton	Ewa
Ewa Plantation Co.	*	G. F. Renton	Ewa
Waianae Co.	***	Fred Meyer	Waianae
Waialua Agricultural Co.	*	W. W. Goodale	Waialua
Kahuku Plantation Co.	x*	Andrew Adams	Kahuku
Waimanalo Sugar Co.	**	G. Chalmers.	Waimanalo
Oahu Sugar Co.	x	E. K Bull	Waipahu
Honolulu Plantation Co.	**	J. A. Low	Aiea
Laie Plantation	x*	S. E. Wooley	Laie
MAUI.			
Olowalu Co.	**	Geo. Gibb	Lahaina
Pioneer Mill Co.	x	L. Barkhausen	Lahaina
Wailuku Sugar Co.	**x	C. B. Wells	Wailuku
Hawaiian Commercial & Sug. Co.	x*	H. P. Baldwin	Puunene
Maui Agricultural Co		H. A. Baldwin	Paia
Kipahulu Sugar Co.	x	A. Gross	Kipahulu
Kihei Plantation Co.	x*	James Scott	Kihei
HAWAII.			
Paauhau Sugar Plantation Co.	**	Jas. Gibb	Hamakua
Hamakua Mill Co.	*x	A. Lidgate	Paauilo
Kukaiau Plantation	x	J. M. Horner	Kukaiau
Kukaiau Mill Co.	*x	E. Madden	Paauilo
Ookala Sugar Co.	**x	W. G. Walker	Ookala
Laupahoehoe Sugar Co.	*x	C. McLennan	Papaaloa
Hakalau Plantation	x	J. M. Ross	Hakalau
Honomu Sugar Co.	**x	Wm. Pullar	Honomu
Pepeekeo Sugar Co.	**x	Jas. Webster	Pepeekeo
Onomea Sugar Co.	**x	J. T. Moir	Hilo
Hilo Sugar Co.	**	J. A. Scott	Hilo
Hawaii Mill Co.	x	W. H. Campbell	Hilo
Waiakea Mill Co.	*x	C. C. Kennedy	Hilo
Hawaiian Agricultural Co.	**x	Wm. G Ogg	Pahala
Hutchinson Sugar Plantation Co.	**	Carl Wolters	Naalehu
Union Mill Co.	*x	H H. Renton	Kohala
Kohala Sugar Co.	*	E. E. Olding	Kohala
Pacific Sugar Mill	x**	D. Forbes	Kukuihaele
Honokaa Sugar Co.	x**	K. S Gjerdrum	Honokaa
Olaa Sugar Co.	xx	J. Watt	Olaa
Puna Sugar Co.			Kapoho
Halawa Plantation	x*x	T. S. Kay	Kohala
Hawi Mill & Plantation	††	John Hind	Kohala
Puako Plantation	††	Jno. C. Searle	S. Kohala
Niulii Sugar Mill and Plantation	*x	Robt Hall	Kohala
Puakea Plantation	*x	H. R. Bryant	Kohala
KAUAI.			
Kilauea Sugar Plantation Co.	**	Frank Scott	Kilauea
Gay & Robinson	x*x	Gay & Robinson	Makaweli
Makee Sugar Co.		G. H. Fairchild	Kealia
Grove Farm Plantation	x	Ed. Broadbent	Lihue
Lihue Plantation Co.	x	F. Weber	Lihue
Koloa Sugar Co.	x	P. McLane	Koloa
McBryde Sugar Co.	*x	W. Stodart	Eleele
Hawaiian Sugar Co.	x*	B. D. Baldwin	Makaweli
Waimea Sugar Mill Co.	*	J. Fassoth	Waimea
Kekaha Sugar Co.	x	H. P. Faye	Kekaha

KEY.

	Castle & Cooke ( )
**	W. G. Irwin & Co. (8)
***	J. M. Dowsett (1)
x	H. Hackfeld & Co. (9)
*x	T. H. Davies & Co. (8)
**x	C. Brewer & Co. (6)
x*	Alexander & Baldwin (6)
x**	F. A. Schaefer & Co. (2)
x*x	H. Waterhouse Trust Co. (2)
††	Hind, Rolph & Co. (2)
xx	Bishop & Co. (1)

HONOLULU AGENTS.

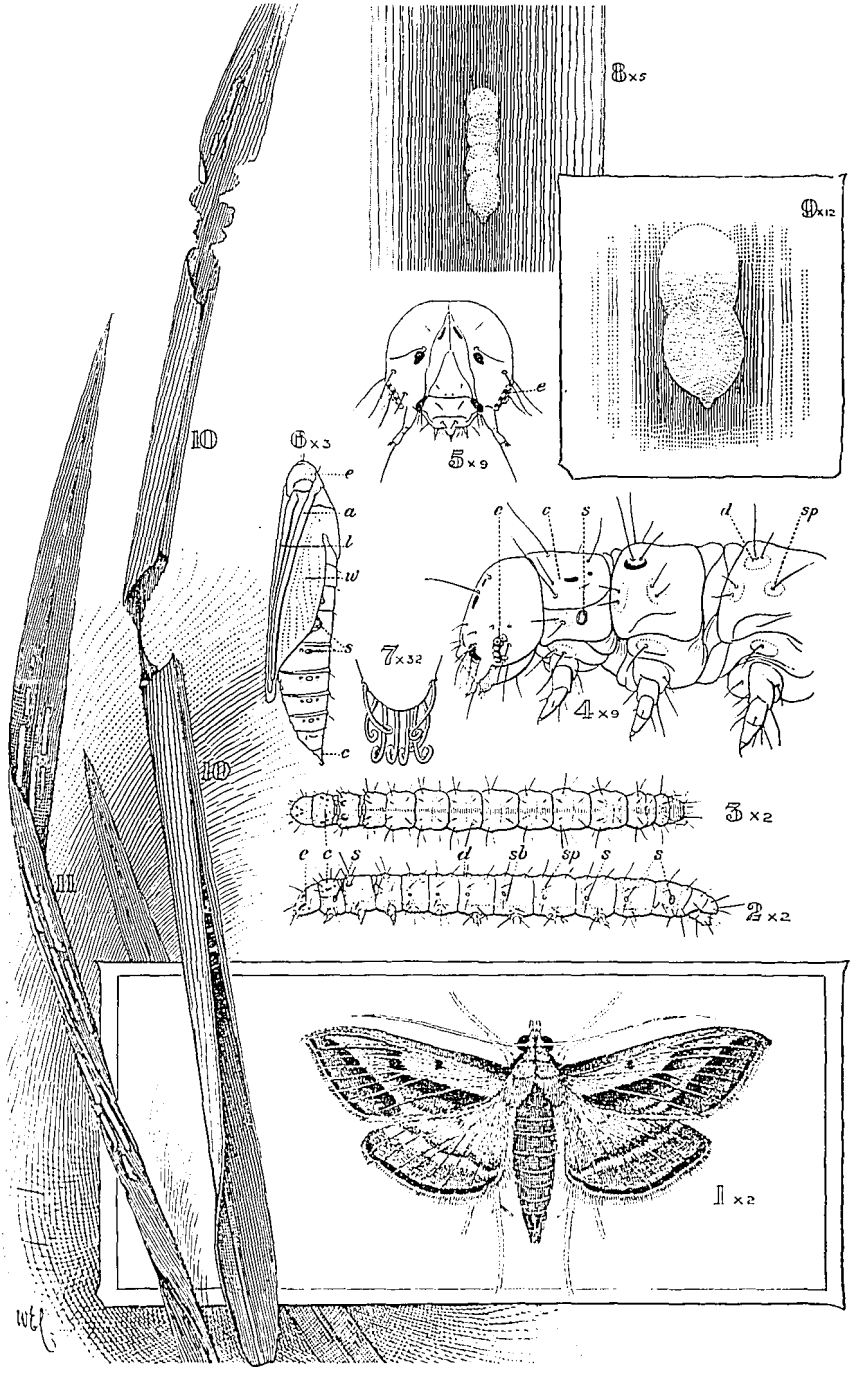

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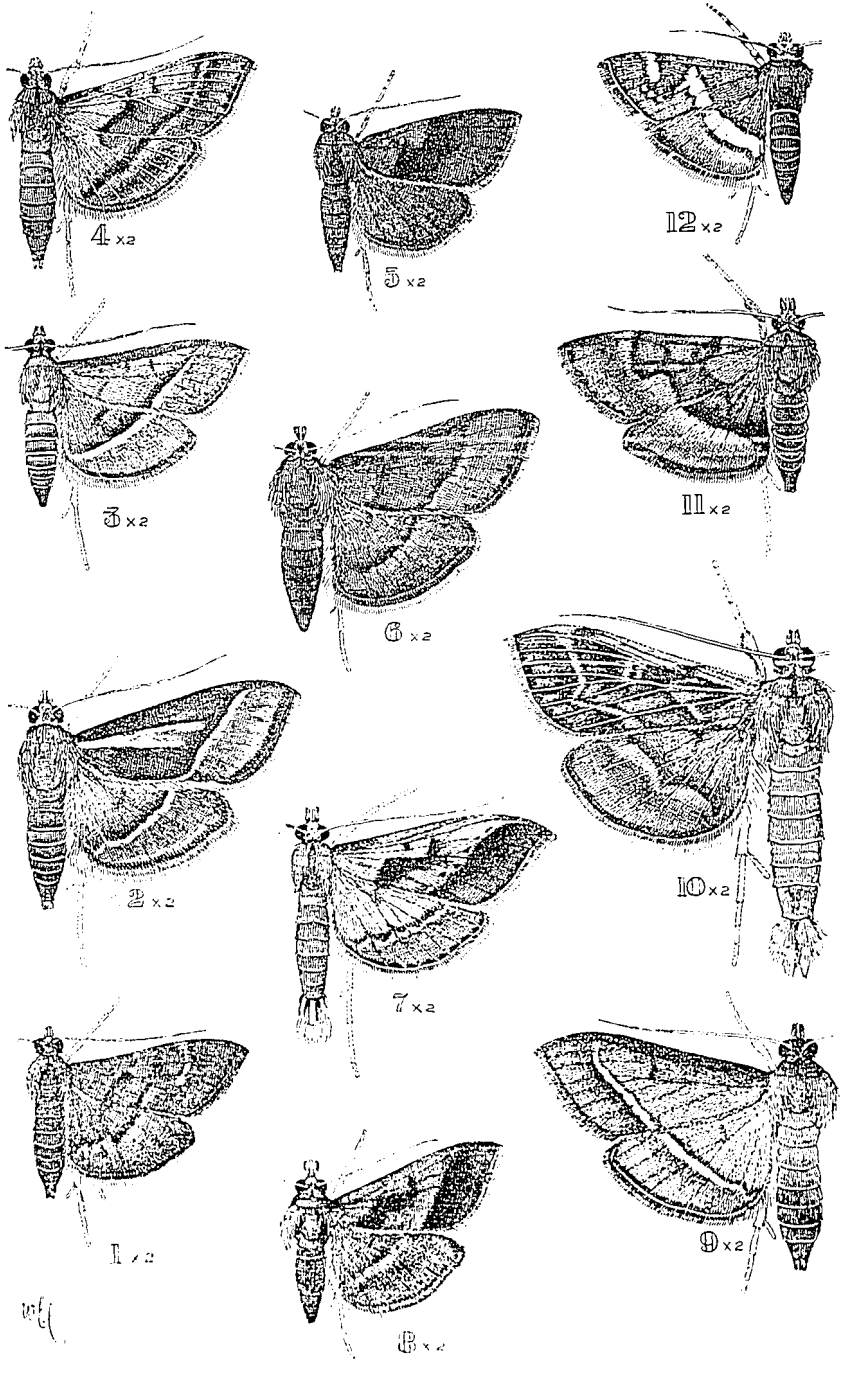
Plate 1.



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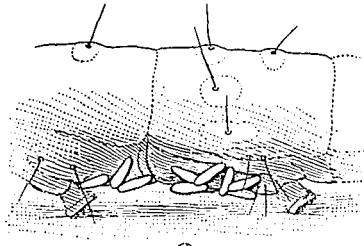

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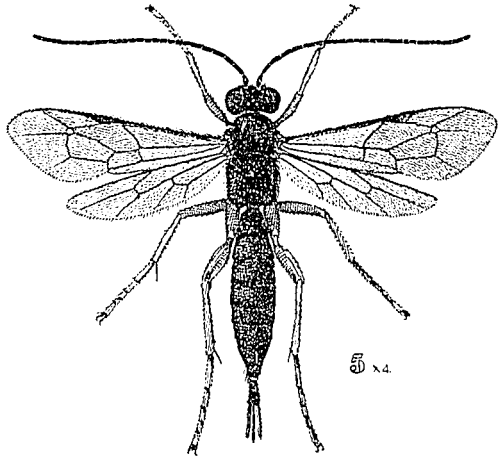

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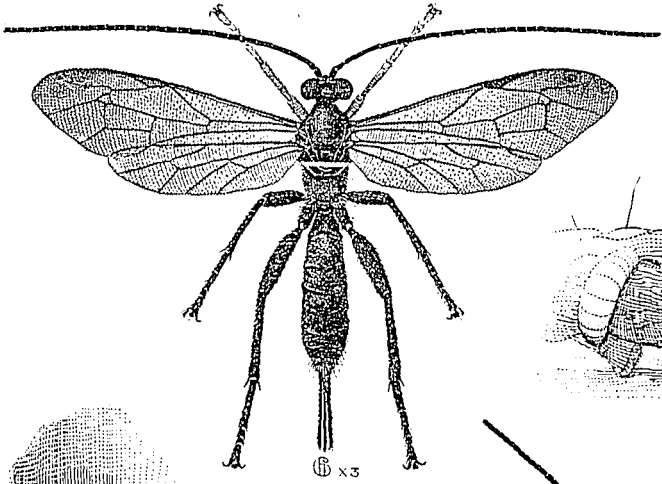

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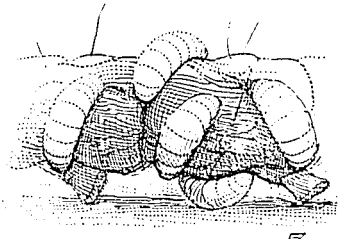

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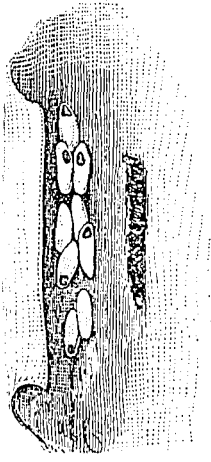
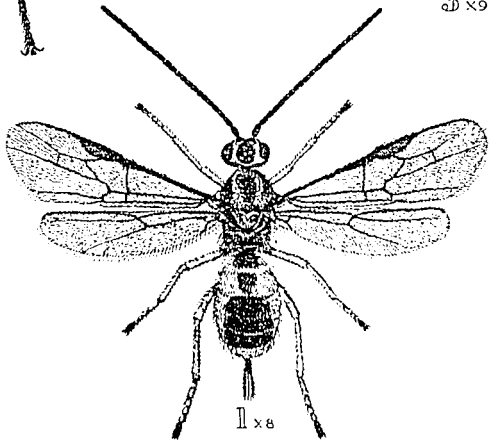


4



1 x8

Plate V.